



Progress report for JSEP Graduate Fellow Dan Stamper-Kurn, Fellowship  
#N00014-98-1-0039, 8/98 - 8/99.

My second year (1998 - 1999) as a JSEP graduate fellow was especially productive. For one, it was a great year for research. My colleagues and I completed work on six projects, leading to five publications in Physical Review Letters, and one in Science. This work was focused on two areas which became the central achievements of my doctoral research. One achievement was the creation of a spinor Bose-Einstein condensate, a totally new quantum fluid with an interesting and unexplored phenomenology.

Research during the past ~70 years has uncovered a scant number of quantum fluids: liquid helium-4, liquid helium-3, and, in a sense, BCS and high temperature superconductors and the 2D electron gas. The uncovering of spinor condensates should greatly expand our understanding of phenomena observed in some of these other fluids, as well as lead to the discovery of entirely new macroscopic quantum phenomena. We discovered two such novel phenomena: the formation of metastable states and spin transport by quantum tunneling. This experimental work has gathered interest from the atomic and condensed-matter physics communities and has become a hotbed for new theoretical ideas.

A second development in our research was the use of inelastic light scattering to illuminate properties of Bose-Einstein condensates. We developed techniques which allowed us to measure for the first time the coherence length of a condensate and thereby prove that condensates are indeed a single "giant matter-wave," as desired for the eventual application of an atom laser. We also explored further the bulk excitations of a Bose-Einstein condensate, and showed that dynamic correlations in the fluid can greatly suppress light scattering. Along the way, we also discovered a novel form of superradiance, an unexpected optical property of the condensate which arises due to its high degree of motional coherence.

The past year was also an important year in my development as a member in the scientific community and as a public speaker. I received several invitations to speak at research seminars and departmental colloquia. These included engagements at Harvard University, MIT, the National Institute of Standards and Technology in Gaithersburg, the California Institute of Technology, the University of Washington, the University of Chicago, the University of Connecticut, and Yale University. I was also invited to speak at the Gordon Conference of Atomic Physics and at the Many-Body X conference in Seattle.

I continue to appreciate the support I receive as a JSEP graduate fellow, which enables me to continue my research and my development as a scientist.

I am sorry to hear that the JSEP program has been discontinued, as it represents a weakening of support and appreciation for basic scientific research and the long-term gains which accrue from such investigations. It pains me to know that money which for many years had been contributing to the advance of humanity by the pursuit of scientific knowledge will now be used instead to buy guns and bombers.

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